

December 11, 2013

To: Chas Vincent, Chair, WPIC

From: Tim Davis, Administrator, Water Resources Division

Re: Painted Rocks Reservoir Sedimentation Investigation

Purpose

This memorandum describes options and cost estimates to determine the amount of sedimentation in the Painted Rocks Reservoir and possibly to determine if an increase rate of sedimentation due to recent forest fire events is occurring.

Previous Work

There are two sources of information from previous work. The first source is the original 1937 contour map conducted before dam construction. The 1937 survey was contoured and planimeted at a 10-foot contour interval to derive the rating table that is currently used. The 2007 rating table (from the O&M manual) was spot-checked against the 1937 rating table and found to be consistent, with the exception of an 18 acre-foot discrepancy that was identified at elevation 4,705.5 (el. 4,430 in the 1937 datum).

The second source of information is a bathymetric survey conducted by Mark Reller in July 2011. Reller conducted the survey to sell maps to recreationists and was not under contract with the state at that time. The data was collected using orthogonal 50-meter transects at full pool, with closer data collected in regions where the bottom topography varied.

Potential Future Data

If funded, future bathymetric and topographic survey data can be used to compare against previous surveys. Future surveys may be used to establish baseline conditions, pending acceptance or non-acceptance of the existing surveys.

Bathymetric survey costs vary depending upon the vendor, the process used, and the defined scope of services. Two firms were contacted to provide preliminary cost estimates. The estimated costs were approximately \$5,000 and \$30,000. The lower cost estimate is from a local firm and we assume that this reflects a base level of effort. It is difficult for a firm to accurately determine costs until a detailed scope of work and deliverable list is defined.

Discussion

A variety of methodologies are available to quantify reservoir sedimentation rates. The standard practice is to acquire bathymetric data and to compare it to original surveys if possible. In some cases the original survey data may not be available or may not be sufficiently accurate.

The use of the 1937 Painted Rocks data as a baseline and comparing it against the 2011 survey provides an estimate of total sedimentation over the life of the project. While the comparison between the two surveys provide some insight to how much sedimentation may have occurred over the life of the project, it is unlikely that this assumed sedimentation occurred at a steady rate.

Assuming that the existing 1937 and 2011 data is accurate, future surveys could then be used for compare sedimentation rates to verify if it is a linear or nonlinear process. This may provide additional insight to this

project and river system. Combined with an appropriate investigation of the basin characteristics above the reservoir, long-term sedimentation rates could be estimated and later verified through scheduled surveys.

Alternatively, a new volumetric baseline may be established. This can be done by using the 2011 data if sufficiently accurate, or monument and conduct a full bathymetric and topographic survey of the site and river channel upstream of the project for future comparison to regularly scheduled surveys. This method has the advantage that it will be based upon modern bathymetric methods and with proper documentation, will maintain a high level of consistency (i.e., survey conducted at the same cross sections and the same way each time). While this determines sedimentation for the time periods between surveys, long term sedimentation rates will be strongly influenced by individual sedimentation events which will not be representative of long-term rates due to the episodic nature of sediment transport.

Note that the above assumes that the 1937 and 2011 surveys are sufficiently accurate for these purposes.

Option – A Purchase 2011 Bathymetry; Recalculate the Original Volume from the 1937 Rating Table; and Collect Future Data

This option assumes that the 2011 bathymetric survey is sufficiently accurate to establish the baseline data necessary to determine sedimentation rates. It also assumes that future bathymetric surveys are conducted by the same entity that performed the 2011 survey. Costs include procuring the 2011 data and recalculating the reservoir volume from the original 1937 plane table survey. It also includes the preparation of a sediment accumulation map based upon the difference between the two bathymetric surfaces. While DNRC personnel have the expertise to perform the work, existing workload and funding precludes this exercise. Therefore, this work would be contracted out to an appropriate engineering or surveying firm.

<u>Item</u>	<u>Consultant</u>	<u>5-year Cycle *</u>
Data Procurement:	\$3,000	\$5,000
Consultant Services:	\$10,000	\$4,000
<u>Contingency (30%):</u>	<u>\$3,900</u>	<u>\$2,700</u>
Total:	\$16,900	\$11,700

Staff Time (Manage Contracts): 60-hours 60-hours

* Note: This cost estimate assumes the availability of the local consultant to conduct the bathymetric work and that this process is sufficient for the intended purpose. Cost for future work does not reflect inflation.

Option – B Determine Effect of Fires on Reservoir Sedimentation Rate

This option is designed to determine the effect that fires may have on sedimentation rates. A preliminary work plan is included as Attachment A. The cost estimate (Attachment B) has been prepared assuming that a consultant will be retained to conduct the work, in which case it will be necessary to further develop the scope of work and to solicit proposals from qualified consultants. It may also be possible to enter into a cooperative agreement with the USGS or a similar research oriented third party. The USGS has access to technical experts with a wide range of expertise (bathymetry, sediment coring, geophysics, water quality, etc.), and has previously participated in large-scale cooperative studies with DNRC (e.g. hydrologic investigations).

<u>Item</u>	<u>Cost</u>
Task 1 – Review Existing Work	\$5,000
Task 2 – Bathymetric Survey	\$40,000

Task 3 – Field Investigation	\$80,000
Task 4 – Analysis and Report	\$20,000
Task 5 – Future Bathymetry Survey	\$40,000
Contingency (30%):	<u>\$55,500</u>
Total:	\$240,500

Staff Time: 200-hours (Consultant selection, administration and review)

Painted Rocks Reservoir Sedimentation**Summary of Options**

Painted Rocks Dam is an earthfill dam constructed in 1940. The storage capacity of the reservoir, based upon a 1937 survey of the reservoir pool area conducted prior to dam construction, is 32,362 acre-feet. No additional surveys have been conducted since construction for the purpose of updating the reservoir's storage capacity.

Based on the assumptions stated previously, the following preliminary cost estimates reflect:

1. Determining existing reservoir capacity
2. Determining total sediment accumulation since dam construction
3. Determine future sediment accumulation
4. Estimate sediment volume due to fire-induced runoff.

Table 1. Summary of costs and expected results.

Option	Description	Objective Number				Cost
		1	2	3	4	
A	Purchase 2011 bathymetry; recalculate original storage volume; and collect / analyze future data	X	X	X		\$16,900 Initial \$11,700 per 5-years
B	Determine Effect of Fire on Reservoir Sedimentation Rates.	X	X	X	X	\$240,500

Preliminary Work Plan to Determine Effect of Fire on Reservoir Sedimentation Rates

Attachment – A

This preliminary work plan, and the associated cost estimate were developed to assess the likely level of effort necessary to estimate the effect that fires have had on reservoir sedimentation rates. It may be difficult to differentiate pre-reservoir native sediments, fire-mobilized sediments, and sediments that were (or would have been) transported in the absence of fire. It is anticipated that this differentiation will require visual inspection and dating of core samples. This may allow historic sedimentation rates to be evaluated pre and post fire within a given tributary. It will likely be necessary to sample tributaries that have not been affected by fire to provide baseline comparative data. This work plan includes 1-week of sampling. Isotope marker sampling was selected as one potentially viable dating method. Further research will be necessary to refine the scope of work, and to identify different or additional technologies that may successfully complete this work.

Task 1 – Review and Update Existing Work

- Digitize 1937 map and recompute Stage-Storage Table using current methodology
- Obtain 2011 data and reanalyze using same methodology as for 1937 data

Task 2 – Bathymetric Survey

- Conduct new bathymetric survey
- Establish baseline depositional surface (use earliest surface that is sufficiently accurate)
- Compare new survey to previous surveys
- Identify areas of deposition, sediment depths, and associated uncertainty

Task 3 – Field Investigation

- Core using - Vibracore or similar method (ground mount or barge mount)
- Soil Testing – gradation, dating (Cs-137, Pb-210?), other
- Prepare Field Studies Report

Task 4 – Technical Analysis and Final Report

- Prepare Final Report
- Compute expected sedimentation rates and calibrate using data from previous tasks
- Estimate pre and post fire sedimentation rates

Task 5 – Future Investigation

- Complete after next low frequency storm event, or at 10 years, whichever occurs first.
- Bathymetric survey
- Core and soil test
- Prepare Report

Cost Estimate**Attachment - B****Preliminary Cost Estimate
Sedimentation Investigation
Painted Rocks Dam**

11/29/2013

<u>TASK 1</u>	<u>Review and Update Existing Work</u>	<u>Units</u>	<u>Cost</u>	<u>Total</u>	<u>Comments</u>
	Obtain 2011 Data	1 ea	\$	3,000.00	\$ 3,000.00
	Digitize 1937 Data	20 hr		\$100	\$ 2,000.00 Digitize 1937 data, recompute Storage
				\$	5,000.00
<u>TASK 2</u>	<u>Bathymetric Survey</u>				
	Consultant Fees	80 hr	\$	100.00	\$ 8,000.00 Compute sediment depths & uncertainties
	Survey Control	1 ea	\$	2,000.00	\$ 2,000.00
	Bathymetric Survey	1 ea	\$	30,000.00	\$ 30,000.00 Assume Out-of-state consultant
				\$	40,000.00
<u>TASK 3</u>	<u>Field Investigation</u>				
	Consultant Field Investigation	80 hr	\$	100.00	\$ 8,000.00
	Coring Rig - VibraCore+barge	1 week	\$	20,000.00	\$ 20,000.00 Estimate
	Soil Testing, per core	10 ea	\$	5,000.00	\$ 50,000.00 Includes Cs-137 and Pb-120, costs
	Reporting	20 hr	\$	100.00	\$ 2,000.00
				\$	80,000.00
<u>TASK 4</u>	<u>Analysis and Report</u>				
	Technical Analysis	120 hr	\$	100.00	\$ 12,000.00
	Report Preparation	80 hr	\$	100.00	\$ 8,000.00
				\$	20,000.00
<u>TASK 5</u>	<u>Future Bathymetry Survey</u>				
	Consultant Fees	80 hr	\$	100.00	\$ 8,000.00
	Survey Control	1 ea	\$	2,000.00	\$ 2,000.00
	Bathymetric Survey	1 ea	\$	30,000.00	\$ 30,000.00
				\$	40,000.00
				Sub-Total	\$ 185,000.00
				Contingency (30%)	\$ 55,500.00
				Total	\$ 240,500.00
				Say:	\$ 241,800.00